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A Stratigraphically Important New Diatom from the Pleistocene of the North Pacific[1]

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ABSTRACT: *Rhizosolenia matuyamai*, a stratigraphically useful new diatom from the Pleistocene of the north Pacific is described. A detailed paleomagnetic and biostratigraphic study of three deep-sea cores from the north Pacific and Deep Sea Drilling Project (DSDP) site 173 indicate that this species ranges consistently from just below the Jaramillo magnetic event to the lower part of the Jaramillo.

THE PURPOSE OF THIS PAPER is to describe the temporal and spatial distribution of a short-ranging diatom from the Pleistocene of the north Pacific. This form, here called *Rhizosolenia matuyamai*, was previously figured by Schrader (1973, Plate 9, Figures 10, 12, 22, and 33), who identified it as *Rhizosolenia bergonii* Peragallo. Our investigation indicates that its differences from *Rhizosolenia bergonii* are sufficient to designate it as a new taxon. Moreover, its limited geologic range over the north Pacific warrants its separation as a separate taxonomic unit.

MATERIALS AND METHODS

Three oriented (Seyb, Hammond, and Gilliard 1977) deep-sea sediment piston cores were examined along with sediments from DSDP site 173 (Leg 18). The piston cores were recovered from the northwest Pacific in the vicinity of the Hess rise and south Emperor Basin (Table 1). All three cores are similar in lithology, consisting essentially of a brown to yellowish-brown diatom- and radiolaria-rich sediment. The three cores were sampled at 10-cm intervals using 6 cm^3 plastic boxes. Paleomagnetic measurements were made with a cryogenic rock magnetometer. All the paleomagnetic measurements were made before the samples were allowed to dry. Alternating-field partial demagnetization was used to eliminate any magnetic components partially obscuring the characteristic detrital remanence. Stepwise analyses of several samples from each core indicated that the optimum demagetization intensity was 100 oe for core K75-1 and 150 oe for cores K75-2 and K75-3. The response of both the paleomagnetic intensity and direction to partial demagnetization indicated that the samples are very stably magnetized. The median destructive field for all three cores was found to be between 300 and 400 oe. Representative total magnetic moments for samples (after partial demagnetization) vary between 1×10^{-4} and 1×10^{-5} G.

TABLE 1

CORE NUMBER	LATITUDE	LONGITUDE	WATER DEPTH (meters)	CORE LENGTH (meters)
K75-1	37°22′ N	179°36′ W	5,383	17.34
K75-2	38°36′ N	179°20′ E	5,748	17.05
K75-3	33°22′ N	169°05′ E	5,695	17.49
Site 173	39°57′ N	125°21′ W	2,927	333.5

Each core consists almost entirely of brown clays containing generally abundant

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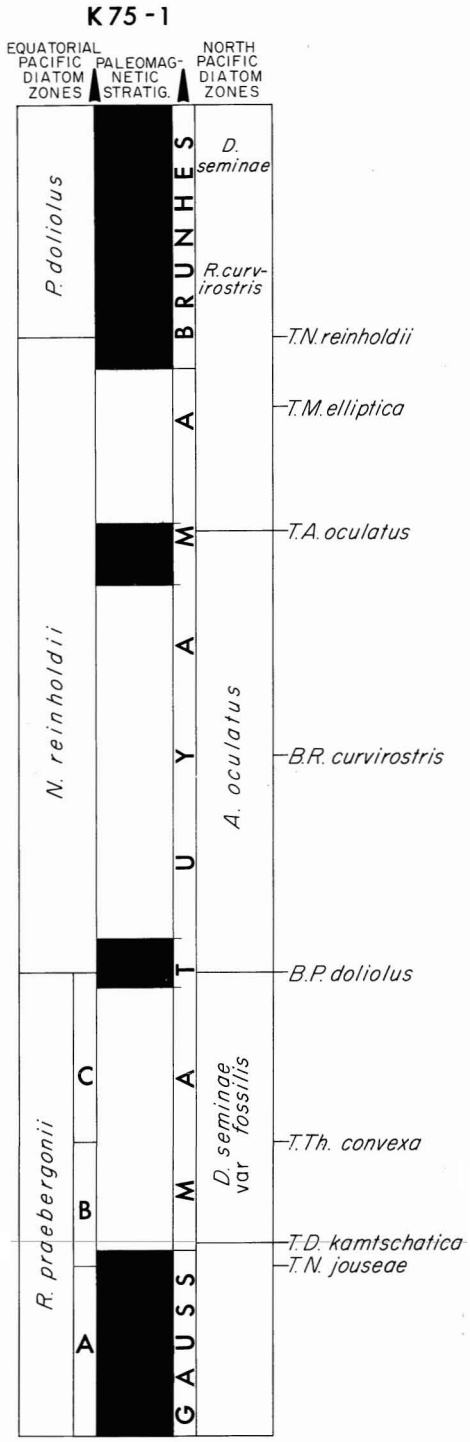


FIGURE 1. Paleomagnetic and biostratigraphic results for core K75–1. The boundary between the *D. seminae* zone and the *R. curvirostris* zone could not be determined. The letter designations in front of the species names on the right side of the chart signify B = base or first appearance and T = top or last appearance.

diatoms along with lesser quantities of radiolarians and sponge spicules. Some intervals in the cores are mottled and others contain relatively abundant manganese micronodules. Deep Sea Drilling Project site 173 is also located in the north Pacific at 39°57.71′ N, 125°21.12′ W. The paleomagnetic results and magnetostratigraphy for sediments from this site are discussed by Heinrichs (1973).

Permanent strew slides and smear slides were made for diatom analysis. The usual sampling interval was 20 cm, but smear slides were examined at 10-cm intervals to determine the upper and lower range of *Rhizosolenia matuyamai*.

RESULTS

In addition to a coherent paleomagnetic reversal record, all the cores examined contained the requisite elements from the high-latitude diatom zonation of Koizumi (1975) and the equatorial Indo-Pacific zonation of Burckle (1972). Figure 1 shows the results of our study of core K75-1. By correlation with the zonation of Burckle (1972), which was previously tied to the magnetic stratigraphy, we can identify the lower normal section as the Gauss, the long reversed section above this as the Matuyama, and the topmost normal section as the Brunhes. Figure 2 demonstrates the paleomagnetic correlation of our three piston cores with this zonal scheme.

Hays et al. (1969) and Burckle (1972) reported that the Jaramillo event of the Matuyama Reversed Epoch could be identified in the equatorial Indo-Pacific by the silicoflagellate, *Mesocena elliptica*, whose geologic range brackets this event. Additionally, Burckle and Opdyke (in press) indicate that the range of *M. elliptica* also brackets

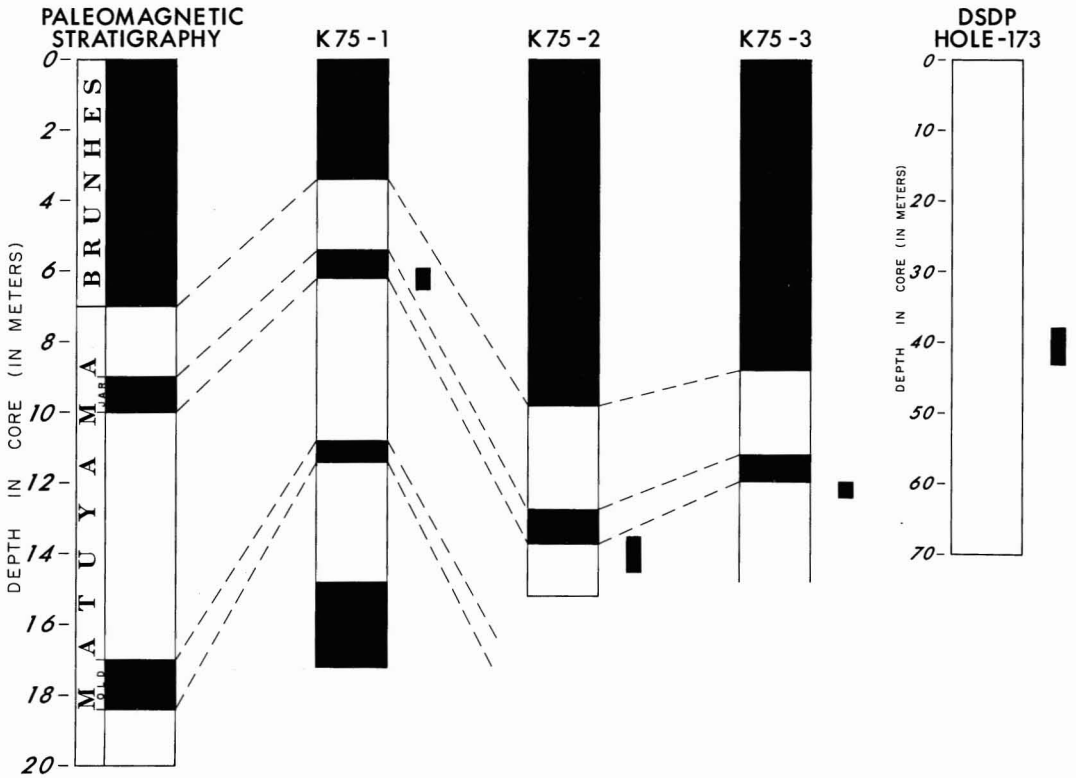
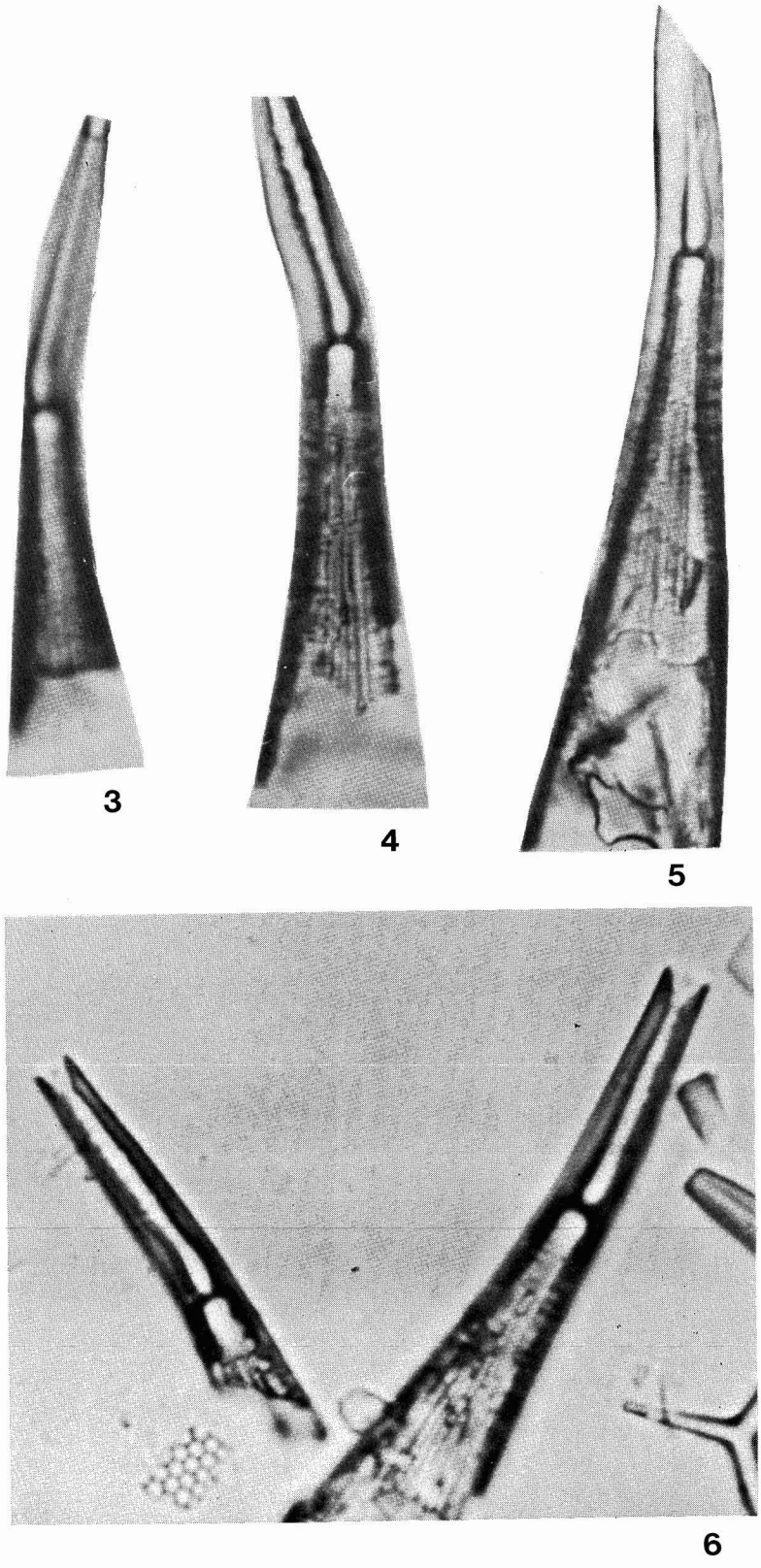


FIGURE 2. Paleomagnetic stratigraphy and range of *Rhizosolenia matuyamai* for three cores from the north Pacific. On the right of each core is the range of this species in DSDP site 173. The basis for the correlation of the paleomagnetic stratigraphy is given in the text.

the Jaramillo in the north Pacific. Ling (1970) discussed the problem of the geologic occurrence of *M. elliptica*. He reported it from the Miocene of the north Pacific as well as the Pleistocene. Similarly, Bukry and Foster (1973) reported that this species ranges from the Late Pliocene to the Middle Pleistocene in the easternmost equatorial Pacific. Burckle (in press) considers these occurrences and demonstrates that the last occurrence of this species is isochronous and is closely related to the onset of Isotopic Stage 22 (Shackleton and Opdyke 1976). In addition to these data, Donahue (1970) showed that the diatom *Actinocyclus oculatus* disappears in the north Pacific near the top of the Jaramillo. Koizumi (1975) used this last appearance to identify the top of his *A. oculatus* zone. These two lines of evidence are used to identify the uppermost normal event within the Matuyama in each of three cores studied as the Jaramillo.

In all three cores, *Rhizosolenia matuyamai* first appeared just below the base of the Jaramillo. In two of the cores, this form last appeared in the lower part of the Jaramillo. In the third core (K75-3, Figure 2), the last occurrence was coincidental with the base of the Jaramillo. It seems apparent to us, therefore, that the lowermost part of the Jaramillo is missing in this core.

To test the biostratigraphic utility of this form, we have reexamined a core from DSDP hole 173 from off the northern coast of California (Table 1). In this core the top of the *A. oculatus* zone occurs at approximately 28 meters, while *R. matuyamai* ranges from 37 to 43 meters. These data are at variance with the paleomagnetic results of Heinrichs (1973), who recorded the Jara-



FIGURES 3–6. *Rhizosolenia matuyamai* sp. nov. All magnifications are ×2000.

millo event between 25 and 28 meters. However, this is regarded as tentative because of the low intensity of the samples (Heinrichs, personal communication 1976).

CONCLUSIONS

Rhizosolenia matuyamai, a new fossil marine diatom, is reported from Middle Pleistocene sediments of the north Pacific. This form should help resolve problems in biostratigraphy and correlation in high northern latitudes.

APPENDIX: TAXONOMIC NOTE[4]

Genus *Rhizosolenia* Ehrenberg (1841)
Rhizosolenia matuyamai sp. nov.

Figures 3–6

Description: Valve cylindrical, moderately robust, widened at the base, and tapering toward the apex. Rows of radial punctae run from base of valve to just below the apical process. Apical process is long, tapering with a moderate to pronounced bend just above its base. This bend ranges from 7 to 20°. A central canal runs the entire length of the apical process. At the base, the canal widens into a teardrop-shaped cavity (ampulla). At the apical end a V-shaped slot projects into the central canal.

Discussion: This species differs from *Rhizosolenia bergonii* by the pronounced bend near the base of the apical process. This bend is the single most important feature of this new form.

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[4] Prepared by Lloyd H. Burckle.

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